UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

July 18, 2007
Revised July 31, 2007

**MEMORANDUM**

**Subject:** Efficacy Review for Antimicrobial Copper Alloys – Group V;
EPA Reg. No. 82012-L; DP Barcode: D335588

**From:** Marcie Tidd, Microbiologist
Product Science Branch
Antimicrobials Division (7510P)

**Thru:** Tajah Blackburn, Acting Team Leader
Product Science Branch
Antimicrobials Division (7510P)

Michele E. Wingfield, Chief
Product Science Branch
Antimicrobials Division (7510P)

**To:** Marshall Swindell PM 33 / Karen Leavy
Regulatory Management Branch I
Antimicrobials Division (7510P)

**Applicant:** Copper Development Association
260 Madison Avenue
New York, NY 10016

**Formulation from the Label:**

| Active Ingredient(s) | % by wt. |
|---|---|
| Copper | 66.5% |
| Other Ingredients | 33.5% |
| Total | 100.0% |

## I. BACKGROUND

The product, Antimicrobial Copper Alloys – Group V, is a new product (Registration Number 82012-L). The product is intended for use in the manufacture of touch-surface products for hospital/medical, institutional, and commercial environments. Thirteen studies are being submitted to support claims for non-food contact surface bacteria reduction, residual bacteria reduction, and continual bacteria reduction. Protocols for this testing were previously submitted and found to be technically sound and acceptable for supporting specified label claims (see October 30, 2006 review by N. Whyte). Submitted studies were conducted by ATS Labs, located at 1285 Corporate Center Drive, Suite 110 in Eagan, MN 55121.

The data package contained a data matrix, the proposed label (pinpunched 12/05/06), three copies of the summary of efficacy testing results, and 13 studies (MRID Numbers 469995-03 through 469995-15) with Statements of No Data Confidentiality and Good Laboratory Practice for all. A letter from the registrant was later provided on 4/3 upon request to the product reviewer.

## II. USE DIRECTIONS

The product is intended for use in the manufacture of touch-surface products for hospital/medical, institutional, and commercial environments such as hospitals, medical offices, nursing homes, schools, athletic facilities, dwellings, lodgings, office buildings retail areas, and mass transit systems. The product may be used in the manufacture of such items as bedrails, bed-side tables, carts, water fountains, faucets, door handles, showerheads, toilet hardware, light switches, chair armrests and frames, floor tiles, knobs, IV poles, physical therapy equipment, elevators, soap dispensers, lockers, and outdoor playground equipment.

The proposed label lacks a section for directions for use. The label does mention that routine cleaning and sanitization of surfaces is required. "Cleaning agents typically used for traditional touching surfaces are permissible; the appropriate cleaning agent depends on the type of soiling and the measure of sanitization required." The surface must remain exposed and uncoated.

## III. AGENCY STANDARDS FOR PROPOSED CLAIMS

**Standards Specific to This Protocol**
Modified versions of two acceptable Agency methods, combined with a novel method, were merged to generate a test system to represent residual self-sanitizing. The method, *Standard Test Method for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces*, was modified to extend the contact time from 5 minutes to 120 minutes. Subsequent testing was modified to follow the *EPA Protocol for Residual Self-sanitizing Activity of Dried Chemical Residues on Hard Non-porous Surfaces*; these modification included (1) changing the exposure time from 5 minutes to 120 minutes,

and (2) replacing the coated antimicrobial surfaces with copper alloy surfaces. A third method was developed to show that copper surfaces could be effective after numerous, sequential re-inoculations. Briefly, the initial 5 µl inoculations were sequentially applied at 0, 3, 6, 12, 18, and 21 hours, resulting in 40 µl of inoculum applied over 24 hours. Next, multiple quantitative recoveries were performed at 2, 6, 12, 18, and 24 hours to access reductions from multiple inoculations. To support a claim for residual self-sanitizing efficacy of a copper alloy surface, a minimum of a 99.9%* reduction in numbers of the test organism(s) on the test surface compared to the number of test organism(s) on the control surface must be achieve at all recovery times over the 24 hour inoculation and exposure period (N. Whyte, Protocol review October 30, 2006).

Note: The 99.9% reduction listed in the above reference protocol review is a typo. The protocol for continuous reduction of bacterial contamination listed a 90% reduction as a performance standard.

**Sanitizer Test (for inanimate, non-food contact surfaces)**

The effectiveness of sanitizers for non-food contact surfaces must be supported by data that show that the product will substantially reduce the numbers of test bacteria on a treated surface over those on an untreated control surface. The test surface(s) should represent the type(s) of surfaces recommended for treatment on the label, i.e., porous or non-porous. Products that are represented as "one-step sanitizers" should be tested with an appropriate organic soil load, such as 5 percent serum. Tests should be performed with each of 3 product samples, representing 3 different product lots, one of which is at least 60 days old against *Staphylococcus aureus* (ATCC 6538) and either *Klebsiella pneumoniae* (aberrant, ATCC 4352) or *Enterobacter aerogenes* (ATCC 13048 or 15038). Results must show a bacterial reduction of at least 99.9 percent over the parallel control within 5 minutes. These Agency standards are presented in DIS/TSS-10.

**Supplemental Recommendations**

Antimicrobial agents which claim to be "one-step" cleaner-disinfectants, or cleaner-sanitizers, or agents to be used in the presence of organic soil, must undergo appropriate efficacy testing modified to include a representative organic soil of 5% blood serum. A suggested method to simulate antimicrobial treatment of dry inanimate surfaces is to add the blood serum 5% v/v (19mL bacterial inoculum with 1mL blood serum) to bacterial inoculum prior to carrier contamination and drying. Control data should be produced as described in Supplemental Recommendation 6 of DIS/TSS-2 to confirm the validity of this test with this modification. The suggested organic soil level is appropriate for simulation of lightly to moderately soiled surfaces. For highly soiled surfaces, a prior cleaning step should be recommended on the product label. A suggested procedure for incorporating organic soil load where the antimicrobial agent is not tested against a dry inanimate surface, such as the AOAC Fungicidal Test involves adding 5% v/v blood serum directly to the test solution (e.g., 4.75 ml test solution + 0.25 ml blood serum) before adding 0.5 ml of the required level (5 X $10^6$ /ml) of conidia. These agency standards can be found in DIS/TSS-2.

## IV. SUMMARY OF SUBMITTED STUDIES

**1. MRID 469995-13 "Test Method for Efficacy of Copper Alloy Surfaces as a Sanitizer" for Alloy C75200 by Amy S. Jeske. Study conducted by ATS Labs, Project Number A03847. Study completed November 6, 2006.**

This test was conducted against *Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048) following ATS Labs protocol number CSC02040406.CUST.1B (copy later provided upon request). Three lots (Lot Nos. 3638980, 3639100 and 3661530) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Five carriers were tested per material per organism. Each carrier was inoculated with a 0.02 mL aliquot of each 48±4 hour old culture and spread to within 1/8 inch of the carrier edges. Carriers were dried at room temperature for 20-40 minutes. Immediately following the drying period, the 120 minute exposure period began. Following exposure, carriers were transferred to 20 mL of neutralizer (Letheen Broth) and sonicated for 5 minutes to suspend cells from carriers. Serial dilutions ($10^{-1}$-$10^{-4}$) of the neutralized solutions were prepared and plated in duplicate on BAP plates (Tryptic Soy Agar with 5% sheep blood) using standard spread plate technique. *S. aureus* plates were incubated at 35-37C for 48±4 hours prior to observation. *E. aerogenes* plates were incubated at 25-30C for 48±4 hours prior to observation. Following incubation, plates were visually enumerated. Cultures containing 30-300 colonies were used for calculations when possible. Controls included those for purity, sterility, viability, neutralization confirmation, inoculum count and carrier quantitation.

Note: There were no survivors reported on any of the copper test carriers.

Note: The study indicates the following claim(s) are supported by this data:
"This surface kills greater than 99.9% of bacteria* within two hours"
*[Including *Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048)]

**2. MRID 469995-15 "Test Method for Efficacy of Copper Alloy Surfaces as a Sanitizer" for Alloy C75200 by Amy S. Jeske. Study conducted by ATS Labs, Project Number A03849. Study completed November 6, 2006.**

This test was conducted against Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442) following ATS Labs protocol number CSC02040406.CUST.1C (copy later provided upon request). Two lots (Lot Nos. 3638980 and 3639100) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Five carriers were tested per material per organism. Each carrier was

inoculated with a 0.02 mL aliquot of each 48±4 hour old culture and spread to within 1/8 inch of the carrier edges. Carriers were dried at room temperature for 20-40 minutes. Immediately following the drying period, the 120 minute exposure period began. Following exposure, carriers were transferred to 20 mL of neutralizer (Letheen Broth) and sonicated for 5 minutes to suspend cells from carriers. Serial dilutions ($10^{-1}$-$10^{-4}$) of the neutralized solutions were prepared and plated in duplicate on BAP plates (Tryptic Soy Agar with 5% sheep blood) using standard spread plate technique. Plates were incubated at 35-37C for 48±4 hours prior to observation. Subculture plates were stored at 2-8C for two days prior to observation. Following incubation and storage, plates were visually enumerated. Cultures containing 30-300 colonies were used for calculations when possible. Controls included those for purity, sterility, viability, neutralization confirmation, inoculum count and carrier quantitation.

Note: There were no survivors reported on any of the copper test carriers.

Note: The study indicates the following claim(s) are supported by this data:
"This surface kills greater than 99.9% of bacteria* within two hours"
*[Including Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)]

**3. MRID 469995-14 "Test Method for Residual Self-Sanitizing Activity of Copper Alloy Surfaces" for Alloy C75200 by Amy S. Jeske. Study conducted by ATS Labs, Project Number A03848. Study completed November 6, 2006.**
This test was conducted against *Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048) following ATS Labs protocol number CSC02040406.CUST.2A (copy later provided upon request). Three lots (Lot Nos. 3638980, 3639100 and 3661530) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Five carriers were tested per material per organism per time point. Each carrier was inoculated with a 10 µL aliquot of each 48-54 hour old culture suspensions and spread to within 1/8 inch of the carrier edges. Carriers were dried at 35-37C for 30 minutes at a 38-42% relative humidity. Immediately following drying, the 120 minute exposure period began at ambient conditions. After this exposure period, carriers were transferred to 30 mL neutralizer (Letheen Broth) jars and sonicated for 20±2 seconds in a sonicating waterbath and mixed on an orbital shaker for 3-4 minutes at 250 rpm. Neutralized samples were serially diluted in sterile deionized water and plated in duplicate within one hour of neutralization. *S. aureus* plates were incubated at 35-37C and *E. aerogenes* plates were incubated at 25-30C for 48±4 hours prior to evaluation. Following incubation, plates were visually enumerated. Cultures containing 30-300 colonies were used for calculations when possible. After this initial inoculation, a series of 12 wear cycles with dry and moist cloths with reinoculation and drying between each were conducted. Each wear cycle consisted of one pass to the left and a return pass to the right on a Gardner scrubber with an abrasion boat fitted with a foam liner and dry or wet cotton cloth. 15 minutes after each wear cycle, carriers were reinoculated and dried for at least 30 minutes. Following the last wear cycle, a final inoculation

was performed with a 120 minute contact time and recovered as in the initial inoculation. Controls included those for purity, sterility, viability, neutralization confirmation, and inoculum population.

Note: The study indicates the following claim(s) are supported by this data:
"This surface kills greater than 99.9% of bacteria* for 24 hours"
*[Including *Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048)]

**4. MRID 469995-07 "Test Method for Residual Self-Sanitizing Activity of Copper Alloy Surfaces" for Alloy C75200 by Jill Ruhme. Study conducted by ATS Labs, Project Number A03440. Study completed November 9, 2006.**
This test was conducted against Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442) following ATS Labs protocol number CSC02032905.CUST.2J (copy later provided upon request). Two lots (Lot Nos. 3638980 and 3639100) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Four carriers were tested per material per organism per time point. Each carrier was inoculated with a 10 µL aliquot of each 48-54 hour old culture suspensions and spread to within 1/8 inch of the carrier edges. Carriers were dried at 35-37C for 30 minutes at a 38-42% relative humidity. Immediately following drying, the 120 minute exposure period began at ambient conditions. After this exposure period, carriers were transferred to 30 mL neutralizer (Letheen Broth) jars and sonicated for 20±2 seconds in a sonicating waterbath and mixed on an orbital shaker for 3-4 minutes at 250 rpm. Neutralized samples were serially diluted in sterile deionized water and plated in duplicate within one hour of neutralization. Plates were incubated at 35-37C for 48±4 hours prior to evaluation. Following incubation, plates were visually enumerated. Cultures containing 30-300 colonies were used for calculations when possible. After this initial inoculation, a series of 12 wear cycles with dry and moist cloths with reinoculation and drying between each were conducted. Each wear cycle consisted of one pass to the left and a return pass to the right on a Gardner scrubber with an abrasion boat fitted with a foam liner and dry or wet cotton cloth. 15 minutes after each wear cycle, carriers were reinoculated and dried for at least 30 minutes. Following the last wear cycle, a final inoculation was performed with a 120 minute contact time and recovered as in the initial inoculation. Controls included those for purity, sterility, viability, neutralization confirmation, and inoculum population.

Note: The study indicates the following claim(s) are supported by this data:
"This surface kills greater than 99.9% of bacteria* for 24 hours"
*[Including Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)]

5. **MRID 469995-12 "Test Method for the Continuous Reduction of Bacterial Contamination on Copper Alloy Surfaces" for Alloy C75200 by Amy S. Jeske. Study conducted at ATS Labs, Project Number A03846. Study completed November 6, 2006.**
This test was conducted against *Staphylococcus aureus* ATCC 6538 and *Enterobacter aerogenes* ATCC 13048 following ATS Labs protocol number CSC02040406.CUST.3B (copy later provided upon request). Three lots (Lot Nos. 3638980, 3639100 and 3661530) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Five sterile carriers were tested per material, per organism, per time point for a total of 150 test carriers and 30 control carriers. Exposure began at time zero when 5 µl of the 24-54 hour old cultures was spread over each of the carriers, which were dried at ambient conditions throughout the exposure period. Carrier sets not removed for quantitative recovery were reinoculated as described above at 3, 6, 9, 12, 15, 18, and 21 hours. At 2, 6, 12, 18, and 24 hours, sets of test and control carriers were removed for quantitative recovery and transferred to 20 mL of Letheen Broth each to neutralize. Each neutralizer/carrier tube was sonicated for 5 minutes to remove survivors and serially diluted within one hour. Dilutions were plated in duplicate on Tryptic Soy Agar with 5% Sheep Blood (BAP). *S. aureus* plates were incubated at 35-37C for 48±4 hours prior to observation and *E. aerogenes* plates were incubated at 25-30C for 48±4 hours. Subcultures were stored at 2-8C for two days prior to examination. Following incubation and storage, plates were visually enumerated. Subcultures showing growth were subcultured, stained and/or biochemically assayed (unspecified assay type) to confirm presence or absence of the test organism. Controls included those for purity, sterility, viability, neutralization confirmation, and inoculum and carrier quantitation.

Note: The study indicates the following claim(s) are supported by this data:
"This surface continuously reduces bacterial* contamination."
"This surface provides continuous/ongoing/persistent antimicrobial action even with repeated exposures."
"This surface continuously kills over 90% of bacteria* after repeated exposures during a day."
"This surface prevents the buildup of disease-causing bacteria*."
"This surface delivers continuous, long-lasting antibacterial* activity."
*[]Including *Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048)]

6. **MRID 469995-04 "Test Method for the Continuous Reduction of Bacterial Contamination on Copper Alloy Surfaces" for Alloy C75200 by Jill Ruhme. Study conducted at ATS Labs, Project Number A03210. Study completed November 9, 2006.**
This test was conducted against Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442) following ATS Labs protocol number CSC02032905.CUST.3J (copy later provided upon request). Two lots (Lot Nos. 3638980 and 3639100) of alloy C75200 (a ready-to-use material) were tested. Fetal bovine serum was added to both cultures to create a 5% organic soil load

supplemented with Triton X-100 (0.01%). Carriers consisted of 1" x 1" squares of the copper alloy test surface and 1" x 1" squares of stainless steel as a control surface. In preparation for the test, carriers were cleaned (following ATS SOP CGT-4340C, "Preparation of Carriers for Use in Testing"), rinsed with deionized water, and allowed to air dry. Carriers were flame sterilized prior to testing. Five sterile carriers were tested per material, per organism, per time point for a total of 150 test carriers and 30 control carriers. Exposure began at time zero when 5 µl of the 24-54 hour old cultures was spread over each of the carriers, which were dried at ambient conditions throughout the exposure period. Carrier sets not removed for quantitative recovery were reinoculated as described above at 3, 6, 9, 12, 15, 18, and 21 hours. At 2, 6, 12, 18, and 24 hours, sets of test and control carriers were removed for quantitative recovery and transferred to 20 mL of Letheen Broth each to neutralize. Each neutralizer/carrier tube was sonicated for 5 minutes to remove survivors and serially diluted within one hour. Dilutions were plated in duplicate on Tryptic Soy Agar with 5% Sheep Blood (BAP). Plates were incubated at 35-37C for 48±4 hours prior to observation. Following incubation, plates were visually enumerated. Subcultures showing growth were subcultured, stained and/or biochemically assayed (unspecified assay type) to confirm presence or absence of the test organism. Controls included those for purity, sterility, viability, neutralization confirmation, and inoculum and carrier quantitation.

Note: The study indicates the following claim(s) are supported by this data:
"This surface continuously reduces bacterial* contamination."
"This surface provides continuous/ongoing/persistent antimicrobial action even with repeated exposures."
"This surface continuously kills over 90% of bacteria* after repeated exposures during a day."
"This surface prevents the buildup of disease-causing bacteria*."
"This surface delivers continuous, long-lasting antibacterial* activity."
*[Including Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)]

**7. The following additional studies were also submitted but not reviewed, as they were conducted as part of the protocol development process and are not intended to support product registration (per June 7, 2007 letter from the applicant's representative).**

| MRID | Method | Organisms |
|---|---|---|
| 469995-03 | Continuous Reduction | *S. aureus, E. aerogenes* |
| 469995-05 | Bacteria Reduction | *S. aureus, E. aerogenes* |
| 469995-06 | Bacteria Reduction | MRSA, *E. coli* O157:H7, *P. aeruginosa* |
| 469995-08 | Residual Bacteria Reduction | *S. aureus, E. aerogenes* |
| 469995-09 | Bacteria Reduction | *S. aureus, E. aerogenes* |
| 469995-10 | Residual Bacteria Reduction | *S. aureus, E. aerogenes* |
| 469995-11 | Continuous Reduction | *S. aureus, E. aerogenes* |

## V. RESULTS

**Bacteria Reduction Test Method for Efficacy of Copper Alloy Surfaces**

| MRID | Organism | Inoculum Count (CFU/mL) | Steel Carrier Control (mean CFU/ Carrier) | Results (Mean Survivors/Carrier) | | | Percent Reduction over Steel Control |
|---|---|---|---|---|---|---|---|
| | | | | Lot 3638980 | Lot 3639100 | Lot 3661530 | |
| 469995-13 | *S. aureus* | $6.3 \times 10^8$ | $3.63 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | *E. aerogenes* | $2.54 \times 10^9$ | $2.04 \times 10^7$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| 469995-15 | MRSA | $3.8 \times 10^8$ | $4.47 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | | >99.9 |
| | *E. coli* O157:H7 | $6 \times 10^7$ | $1.86 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | | >99.9 |
| | *P. aeruginosa* | $1.4 \times 10^8$ | $3.63 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | | >99.9 |

*Carrier counts of zero were reported as $<2.00 \times 10^2$.

**Test Method for Residual Bacteria Reduction of Copper Alloy Surfaces**

| MRID | Organism | | Steel Carrier Control (mean CFU/ Carrier) | Results (Mean Survivors/Carrier) | | | Minimum Percent Reduction over Steel Control |
|---|---|---|---|---|---|---|---|
| | | | | Lot 3638980 | Lot 3639100 | Lot 3661530 | |
| 469995-14 | *S. aureus* | 4/25/06 Initial | $2.00 \times 10^6$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | >99.9 |
| | | Final | $5.25 \times 10^5$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | >99.9 |
| | *E. aerogenes* | 4/25/06 Initial | $8.13 \times 10^6$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | >99.9 |
| | | Final | $3.98 \times 10^5$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | $2.69 \times 10^4$ | 99.3 |
| | | 6/13/06 Initial | $3.72 \times 10^6$ | - | - | $<3.02 \times 10^1$ | >99.9 |
| | | Final | $1.17 \times 10^5$ | | | $<5.75 \times 10^1$ | >99.9 |
| 469995-07 | MRSA | Initial | $4.07 \times 10^5$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | - | >99.9 |
| | | Final | $3.02 \times 10^5$ | $<3.02 \times 10^1$ | $<4.90 \times 10^1$ | | >99.9 |
| | *E. coli* O157:H7 | Initial | $1.00 \times 10^5$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | - | >99.9 |
| | | Final | $7.41 \times 10^4$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | | >99.9 |
| | *P. aeruginosa* | Initial | $6.03 \times 10^6$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | - | >99.9 |
| | | Final | $1.32 \times 10^5$ | $<3.02 \times 10^1$ | $<3.02 \times 10^1$ | | >99.9 |

*Carrier counts of zero were reported as $<3.02 \times 10^1$.

**Test Method for the Continuous Reduction of Bacterial Contamination on Copper Alloy Surfaces**

| MRID | Organism | Exposure Time (Hours) | Steel Carrier Control (mean CFU/ Carrier) | Results (Mean Survivors/Carrier) | | | Minimum Percent Reduction over Steel Control |
|---|---|---|---|---|---|---|---|
| | | | | Lot 3638980 | Lot 3639100 | Lot 3661530 | |
| 469995-12 | *S. aureus* | 2 | $2.57 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 6 | $4.37 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 12 | $5.01 \times 10^5$ | $<2.00 \times 10^2$ | $<2.75 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 18 | $1.48 \times 10^6$ | $<4.90 \times 10^2$ | $<3.02 \times 10^3$ | $2.82 \times 10^3$ | 99.8 |
| | | 24 | $2.51 \times 10^6$ | $2.00 \times 10^3$ | $1.05 \times 10^4$ | $9.33 \times 10^3$ | 99.6 |
| | *E. aerogenes* | 2 | $2.82 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 6 | $1.62 \times 10^7$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 12 | $6.92 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 18 | $7.24 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | >99.9 |
| | | 24 | $1.17 \times 10^7$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | $<2.29 \times 10^2$ | >99.9 |
| 469995-04 | MRSA | 2 | $6.61 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 6 | $1.74 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 12 | $3.39 \times 10^6$ | $<2.00 \times 10^2$ | $<2.51 \times 10^2$ | - | >99.9 |
| | | 18 | $1.07 \times 10^7$ | $5.37 \times 10^2$ | $<3.98 \times 10^2$ | - | >99.9 |
| | | 24 | $6.61 \times 10^7$ | $9.55 \times 10^2$ | $4.79 \times 10^2$ | - | >99.9 |
| | *E. coli* O157:H7 | 2 | $1.12 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.8 |
| | | 6 | $9.33 \times 10^4$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.8 |
| | | 12 | $1.00 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.8 |
| | | 18 | $1.66 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 24 | $5.01 \times 10^5$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | *P. aeruginosa* | 2 | $1.78 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 6 | $1.78 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 12 | $2.00 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 18 | $2.57 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |
| | | 24 | $6.17 \times 10^6$ | $<2.00 \times 10^2$ | $<2.00 \times 10^2$ | - | >99.9 |

*Carrier counts of zero were reported as $<2.00 \times 10^2$.

## VI. CONCLUSIONS

1. The submitted data (MRID 469995-13) support the use of the product, Antimicrobial Copper Alloys- Group V, as a **non-food contact surface** against 99.9% of ***Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC** 13048) when incorporated into surfaces in the presence of 5% soil at a contact time of 120 minutes (2 hours). At least a 99.9% (3 log) reduction was produced over stainless steel control surfaces (though 99.9% could not be precisely calculated due to zero growth on test carriers). Other controls were acceptable for a valid test.

2. The submitted data (MRID 469995-15) support the use of the product, Antimicrobial Copper Alloys- Group V, as a **non-food contact surface** against 99.9% of **Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)** when incorporated into surfaces in the presence of 5% soil at a contact time of 120 minutes (2 hours). At least a 99.9% (3 log) reduction was produced over stainless steel control surfaces (though 99.9% could not be precisely calculated due to zero growth on test carriers). Other controls were acceptable for a valid test.

3. The submitted data (MRID 469995-14) support the use of the product, Antimicrobial Copper Alloys- Group V, as a surface with **residual bacterial reduction** against ***Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048)** when incorporated into surfaces in the presence of 5% soil after repeated wet and dry abrasion cycles. At least a 99.9% (3 log) reduction was produced over stainless steel control surfaces in initial and final testing surrounding repeated wear testing (though 99.9% could not be precisely calculated due to zero growth on most of the test carriers). Other controls were acceptable for a valid test.

4. The submitted data (MRID 469995-07) support the use of the product, Antimicrobial Copper Alloys- Group V, as a surface with **residual bacterial reduction** against **Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)** when incorporated into surfaces in the presence of 5% soil after repeated wet and dry abrasion cycles. At least a 99.9% (3 log) reduction was produced over stainless steel control surfaces in initial and final testing surrounding repeated wear testing (though 99.9% could not be precisely calculated due to zero growth on most of the test carriers). Other controls were acceptable for a valid test.

5. The submitted data (MRID 469995-12) support the use of the product, Antimicrobial Copper Alloys- Group V, as a surface with **continuous reduction of bacterial contamination** against ***Staphylococcus aureus* (ATCC 6538) and *Enterobacter aerogenes* (ATCC 13048)** when incorporated into surfaces in the presence of 5% soil over a period of 24 hours. At least a 99% reduction was achieved by ***S. aureus*** and *E. aerogenes* at all time points (though 99% could not be precisely calculated due to zero growth on most of the test carriers).

6. The submitted data (MRID 469995-04) support the use of the product, Antimicrobial Copper Alloys- Group V, as a surface with **continuous reduction of bacterial contamination** against **Methicillin Resistant *Staphylococcus aureus* (MRSA, ATCC 33592), *Escherichia coli* O157:H7 (ATCC 35150), and *Pseudomonas aeruginosa* (ATCC 15442)** when incorporated into surfaces in the presence of 5% soil over a period of 24 hours. At least a 99% reduction was achieved at all time points (though 99% could not be precisely calculated due to zero growth on most of the test carriers). Controls were acceptable for a valid test.

## VII. RECOMMENDATIONS

### A. Regarding Submitted Data

1. The proposed label claims that the product, Antimicrobial Copper Alloys- Group V, effectively reduces 99.9% of the following Gram-negative and Gram-positive bacteria within two hours of exposure on the alloy surface (having undergone routine cleaning).

| | |
|---|---|
| *Staphylococcus aureus* | ATCC 6538 |
| *Enterobacter aerogenes* | ATCC 13048 |
| *Staphylococcus aureus* MRSA | ATCC 33592 |
| *Escherichia coli* O157:H7 | ATCC 35150 |
| *Pseudomonas aeruginosa* | ATCC 15442 |

These claims are currently unacceptable. Due to the extended contact time, this product may not be classified as a "sanitizer." All label references to the product as a sanitizer must be removed. The applicant may instead state that the surface reduces 99.9% of the above bacteria.

2. The proposed label claims that the product, Antimicrobial Copper Alloys- Group V, exhibits **residual bacteria reduction activity** against 99.9% of the following bacteria within 2 hours even after repeated wet and dry abrasion and re-contamination.

| | |
|---|---|
| *Staphylococcus aureus* | ATCC 6538 |
| *Enterobacter aerogenes* | ATCC 13048 |
| *Staphylococcus aureus* MRSA | ATCC 33592 |
| *Escherichia coli* O157:H7 | ATCC 35150 |
| *Pseudomonas aeruginosa* | ATCC 15442 |

These claims are currently acceptable. Due to the extended contact time, this product may not be classified as a "sanitizer." All label references to the product as a sanitizer (including residual self-sanitization) must be removed. The applicant may instead state that the product has residual bacterial reduction activity.

3. The proposed label claims that the product, Antimicrobial Copper Alloys- Group V, exhibits **continuous reduction of bacterial contamination** against 99% of the following bacteria over a period of 24 hours. These claims are acceptable*.

| | |
|---|---|
| *Staphylococcus aureus* | ATCC 6538 |
| *Enterobacter aerogenes* | ATCC 13048 |
| *Staphylococcus aureus* MRSA | ATCC 33592 |
| *Escherichia coli* O157:H7 | ATCC 35150 |
| *Pseudomonas aeruginosa* | ATCC 15442 |

*During the protocol review, a performance standard of a 90% reduction in bacteria over a 24 hour period was agreed upon. The submitted study report also indicated that it was to support label claims for a 90% of bacteria over a 24 hour period. However, test

results were able to demonstrate at least a 99% reduction and these claims were incorporated into the proposed label. Claims for a 99% reduction are acceptable on the condition that the registrant provide an amended test protocol.

**B. Regarding Proposed Label**

1. In review of the submitted efficacy studies, it is apparent that cleaning is required to elicit and maintain 3-log reduction in efficacy. An initial cleaning or "degreasing step" must be included on the label to address removal of residual manufacturing oil and debris. This initial cleaning step will be reserved for newly incorporated surfaces and sites.

   For claims of continuous, long-lasting activity and residual activity, a maintenance cleaning step must also be included on the proposed label. The language for this maintenance cleaning step must indicate that high touch surfaces with significant bioload should be subjected to daily cleaning to elicit continued efficacy, as demonstrated in the test systems. As an extension of label cleaning verbiage, agents compatible with the copper surfaces should be included.

2. The following use surfaces must be removed from the product label.

   --Remove all outdoor surfaces (playground equipment) as the efficacy tests performed do not adequately represent conditions the surfaces would be exposed to in an outdoor environment.

   -- Remove all textiles (uniforms, curtains, sheets, pillow cases), as these are porous surfaces for which efficacy has not been demonstrated.

   -- Remove shopping cart handles and child seats from the proposed label. These surfaces are extremely high-touch surfaces, unlikely to be cleaned every 24 hours. Furthermore these surfaces are likely to be left outside for extended periods.

   In addition, the following use surfaces must also be removed based upon the rationale that they will accumulate significant bioload and are not practical to clean on a consistent basis (every 24 hours). Based upon the submitted data, efficacy may not be demonstrated in the absence of routine/daily cleaning.

   Healthcare Facilities
   Bedrails, footboards
   Bedrails, assistance rails
   Paper towel holders
   Alcohol sanitizer dispenser, handles
   Showerheads
   Visitor chairs, armrest, metal frames
   Closures
   Vertical locking arms
   Vertical cover guards

Protection bars
Thermostat covers
Telephone handsets and surfaces (housings) keyboards
Ceiling tiles (request additional information, regarding types, often these are porous)
Walkers, wheelchair handles, and tubular components
Computer keyboards: keys, housings, computer mouse
Medical records: chart holders, clipboards, filing systems
Storage shelving: wire shelving etc. for medical supplies

Community Facilities
Cash registers: housing, keypads
ATM machines: keys, housing (must be indoor)
Gym/Health club lockers, locker handles locker shelving, trainers' tables
Ice and water dispensers (outer surfaces without water contact)
Windows (crank), Locking mechanism, pull handles
Window treatments (cord pulls), Venetian blinds (wands, cord pulls)
Jalousie Windows (crank)
Casement (cranks, levers, hinges)
Single and double-hung windows (locks and pulls)

3. Those use sites not addressed in the previous item (VII (B) 2) are classified as "practical" and may remain on the label when acceptable cleaning directions are provided.

4. On page 5 of the proposed label, add the phrase "non-food contact only" in parenthesis next to "countertops and tabletops."